

CLAIMS

What is claimed is:

1. A method for enabling synchronization of a
5 communications terminal in a wireless communication
system comprising:

receiving a burst at a receiver of the
communications terminal, the burst containing a composite
waveform including two or more component waveforms,
10 wherein each of the two or more waveforms has a known
frequency variation throughout the burst.

2. The method of Claim 1 further comprising
detecting a first component waveform of said two or more
15 component waveforms.

3. The method of Claim 2 further comprising
detecting a second component waveform of said two or more
waveforms.
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4. The method of Claim 3 further comprising
estimating, after both of said detecting steps, a
frequency offset and a timing offset of said composite
waveform as received into said receiver.
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5. The method of Claim 3 wherein said
detecting said first component waveform comprises
desweeping said first component waveform into a first
deswept component waveform, wherein said first deswept
30 component waveform is a narrow band waveform.

6. The method of Claim 5 further comprising
transforming said first deswept component waveform into a
first frequency domain representation.
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7. The method of Claim 6 wherein said transforming includes using a Fast Fourier Transform.

8. The method of Claim 6 further comprising
5 estimating a signal-to-noise ratio of said first frequency domain representation.

9. The method of Claim 8 further comprising
10 comparing said signal-to-noise ratio of said first frequency domain representation to a threshold.

10. The method of Claim 9 further comprising
15 estimating, in the event said threshold is exceeded, a first peak frequency of said first frequency domain representation.

11. The method of Claim 10 further comprising
20 using a Discrete Fourier Transform to fine-tune the estimate of said first peak frequency.

12. The method of Claim 10 further comprising:
desweeping said second component waveform of
said two or more component waveforms into a second
deswept component waveform; and
25 transforming said second deswept component
waveform into a second frequency domain representation.

13. The method of Claim 12 further comprising
30 estimating a second peak frequency from said second frequency domain representation.

14. The method of Claim 13 further comprising
estimating a frequency offset and a timing offset of said
composite waveform as received into said receiver,
35 whereby synchronization is achieved.

15. The method of Claim 13 wherein said
estimating comprises estimating, using said first peak
frequency and said second peak frequency and said known
frequency variation of each of said first component
5 waveform and said second component waveform.

16. The method of Claim 15 wherein said
frequency offset is defined by the formula:

$$f_d = 0.5(f_1 + f_2)$$

10 wherein f_d is said frequency offset in Hertz, f_1 is said
first peak frequency in Hertz, and f_2 is said second peak
frequency in Hertz.

17. The method of Claim 15 wherein said timing
15 offset is defined by the formula:

$$t_0 = \tau - [(f_1 - f_2)/2K]$$

wherein f_1 is said first peak frequency in Hertz, f_2 is
said second peak frequency in Hertz, K is the absolute
value of said known frequency variation of said each of
20 said first component waveform and said second component
waveform in Hertz/second, and τ is a time in seconds at
which said composite waveform is hypothesized to arrive
at said communications terminal.

25 18. The method of Claim 1 wherein said
receiving comprises receiving said burst through a
channel, wherein said composite waveform has a composite
bandwidth on an order of an available channel bandwidth,
wherein each of said two or more component waveforms has
30 a component bandwidth on the order of the available
channel bandwidth.

19. The method of Claim 18 wherein said
receiving further comprises said receiving, wherein a
35 range of values for the differences between the
instantaneous frequencies of two of said two or more

component waveforms is on an order of twice of said available channel bandwidth.

20. The method of Claim 1 wherein said
5 composite waveform comprises a dual-chirp waveform including an up-chirp waveform and a down-chirp waveform.

21. An acquisition system of a wireless
communications terminal for acquiring a received
10 composite waveform including two or more component waveforms and estimating a frequency offset and a timing offset of the received composite waveform comprising:
a first phase shifter for desweeping a first
component waveform of the received composite waveform;
15 and

a first processor coupled to the first phase shifter for transforming the first component waveform having been deswept into a first frequency domain representation.

22. The system of Claim 21 wherein said first processor is a first fast Fourier transform processor.

23. The system of Claim 21 further comprising
25 a detection processor coupled to said first processor for detecting a peak of said first frequency domain representation, whereby detecting the presence of said first component waveform.

24. The system of Claim 23 wherein said
30 detection processor estimates a first peak frequency of said first frequency domain representation.

25. The system of Claim 24 wherein said
35 detection processor includes a discrete Fourier transform

for fine-tuning the estimation of said first peak frequency.

26. The system of Claim 23 further comprising:
5 a second phase shifter for desweeping a second component waveform of said received composite waveform; and

a second processor coupled to the second phase shifter for transforming the second component waveform,
10 having been deswept, into a second frequency domain representation.

27. The system of Claim 26 wherein said second processor is a second fast Fourier transform processor.
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28. The system of Claim 26 further comprising a detection processor coupled to said second processor for detecting a peak of said second frequency domain representation.
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29. The system of Claim 28 wherein said detection processor estimates a second peak frequency of said second frequency domain waveform.

30. The system of Claim 29 wherein said detection processor includes a discrete Fourier transform for fine-tuning the estimation of said second peak frequency.
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31. The system of Claim 29 wherein said detection processor includes a parameter estimator for computing said frequency offset and said timing offset of said received composite waveform.
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32. The system of Claim 21 wherein said received composite waveform comprises a received dual-chirp waveform.

5 33. The system of Claim 21 further comprising:
a matched filter for filtering the received
composite waveform; and
a buffer coupled to the matched filter, wherein
the buffer is further coupled to said first phase
10 shifter.

34. A method for enabling synchronization of a
communications terminal in a wireless communication
system comprising:
15 receiving a burst at a receiver of the
communications terminal, the burst containing a composite
waveform including two or more component waveforms,
wherein each of the two or more waveforms has a known
frequency variation throughout the burst;
20 detecting the presence of the composite
waveform; and
estimating a frequency offset and a timing
offset of the composite waveform as received into said
receiver, whereby synchronization is achieved.

25 35. The method of Claim 34 wherein said
detecting comprises detecting a first component waveform
of said two or more component waveforms.

30 36. The method of Claim 35 wherein said
detecting said first component waveform comprises:
desweeping said first component waveform into a
first deswept component waveform;
transforming the first deswept component
35 waveform into a first frequency domain representation;
and

determining if the signal to noise ratio of the first frequency domain representation exceeds a threshold.

- 5 37. The method of Claim 36 wherein said estimating comprises:
- estimating a first peak frequency of said first frequency domain representation;
- desweeping said second component waveform into
- 10 a second deswept component waveform;
- transforming the second deswept component waveform into a second frequency domain representation;
- estimating a second peak frequency of the second frequency domain representation;
- 15 estimating said frequency offset and said timing offset using the first peak frequency and the second peak frequency and said known frequency variation of each of said first component waveform and said second component waveform.